

# **AGRO-PASTORAL PRODUCTION SYSTEMS OF HIGH ALTITUDE PASTURES, UPPER KAGHAN VALLEY, NWFP, PAKISTAN**

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## **1. INTRODUCTION**

**1.1** Kaghan valley lies in the northern most portion of Mansehra district and is oriented from north-east to south-west directions. It is surrounded by more or less, parallel ranges of hills which rise to 5291 m asl. The highest peak Malika Parbat stands to the east of the Saif-ul-Maluk, South of it is Ragan Pajji (5038 m) at the head of Shikara Katha (Stream). Other peaks are Shikara and Bichfa (4877 m), Bogi (4852 m), Raja (4720 m). Further south on left side is Makra (3887 m) and on right side is Musa-ka-Musalla (4077 m). The valley is drained by the Kunhar river which originates from Lulusar (a lake) in the north and joins Jhelum River in the south. Its important tributaries, which drain side valleys are Sanghar, Glianul, Bhunja, Manur, Nuran, Batakundi, Dabuka, Jora, Jalkhad and Purbiala (on left bank) and Barna, Jalora, Bhanrun, Bhutandes and Sipat (on right bank).

**1.2** The valley consists of 945.47 square Km. area which is one 3rd of the total area of the district Mansehra. Major land uses are Ranglands (55.5%), Forests (24.6%) and agriculture (6%). The balance (13.9%) area is unclassified (River/stream beds, settlements, rocks and barren land). Cultivation appears on every available spot from small terraces cut with great labour in hill sides to the rich irrigation of valley floors. However, almost all the area of the valley is subjected to grazing with various intensity and frequency.

**1.3** The alpine pastures of Kaghan valley are a potential source of forage for livestock during summer season. A large number of Gujars and Bakarwals (sheep/goat herders) migrate to these areas with or without their families and livestock in early summer and return to lower elevations or plains in early autumn. This pattern of transhumance grazing has become well adopted. The graziers move their livestock higher and higher as the snow pack melts and almost reach the fringe of perpetual snow line. The grazing is practiced heavily without any concepts of range management. Every hook and corner and every ridge and vale, which is accessible, is grazed.

**1.4** The traditional uncontrolled heavy grazing is practiced by the graziers as no technical input is made due to the lack of proper scientific management. The overuse is also due to the prevailing land tenures as the land is owned by different people and is used by the different groups. In the past no study has been carried out to evaluate this traditional use. Hussain (1968) carried out range vegetation analysis to assess the range condition only. This study aims at evaluation of natural production and utilization systems and was carried out in continuation of Saif-ul-Maluk study (Sardar 1997). The inventory of livestock, however, was out of the scope of this study. However, there is need to carry out well planned inventory to estimate the number of transhumant grazing livestock.

**1.5** Extreme northern portions, headwaters of the Kunhar river, of the Kaghan valley were selected for this study. The study area consisted of Burawai, Jalkhad, Basel and Gittidas localities which extend upto Diamer district of the North-West Frontier Province. The study area falls under sub alpine and alpine eco-zones. The elevation of the study area varies from 2925 to 4184 m asl. The area has poor accessibility and a Jeep-able road, along the Kunhar river, remains open for summer months (June to September). These areas, though have great potential for tourism, are important grazing lands for transhumance grazing.

## **2.0 METHODOLOGY**

### **2.1 Sampling/Design**

#### **2.1.1 Summer (Alpine) Pastures**

Four representative range sites, one each, in Burawai, Jalkhad, Basel and Gittidas were selected. These localities were main camping/settlement points of the graziers. On each site, 5 paired-plots, representing almost all the available slopes and micro aspects, were laid out. Both the plots were close enough to each other, at about 1 meter distance. This distance was kept for ease in movement of grazing animals. One plot was fenced and other was kept unfenced for free grazing. Four wooden poles and 5 strands of barbed wire were used for fencing. This arrangements was made to substitute me caged paired plots, which were not possible to install under the prevailing conditions. Each fenced plot was 1.5 x 1.5 square meter. Its clipped area was 1 sq. m. and its all the four corners were marked with wooden pegs. The ungraded plot was 1 sq. meter in size and its corners were also marked with wooden pegs. The fencing material was found damaged mostly due to snowfall and partially due to the herdcrs. Fences were repaired/reerected in the next working season.

#### **2.1.2 Winter (Foot Hills) Pastures**

Two sites one each in Khanpur (NWFP) and Taxila (Punjab) were selected for this study. Dara (Khanpur) and Thatha Khalil (Taxila) grassland/shrubland in dry subtropical zone were two of the winter grazing areas of the Bakarwals. In these study sites 3 transect lines, one 20 steps above the bottom, second in the middle and 3rd 20 steps lower than top/ridge were laid out. On each line 20 quadrats 1 x 1 sq. meter were laid out at 200 steps apart. Total 60 quadrats were studied in each site under weight -estimate method.

#### **2.1.3 Socio-economic conditions of the Graziers**

A questionnaire containing 36 main questions, mostly nonstructural, was formulated for collection of socio-economic conditions of sedentary and nomadic transhumance graziers. Through interview-cum-questionnaire technique the respondents were asked general and specific information on livestock management, movement, mode of grazing, fodder crops production, feed types availability community involvement in range land improvement and problems/issues related to grazing/feed procurement.

Accidental sampling technique was applied. The graziers who were available at camping sites or happened to visit a specific locality or were moving up/down on road and were willing to respond were interviewed. Since in alpine grazing areas their huts were scattered far away from each other and most were not available in or around huts during day times so the accidental samples were studied. During the working seasons only 43 grazier household heads were interviewed. Out of it 29 were sedentary and 14 were nomadic graziers. Among sedentary 9 were Gujars, 5 were Awans and 15 were others (Sayed, Swati, Quresh, Mughal, Rajput and Pathans). Among nomadic majority (13) were Gujars and one was others.

### **2.2 Data Collection**

In alpine pastures the paired-plots were laid out in July, 1998. The species-wise cover percentage within 1 sq. meter, area of fenced and unfenced plots, at time of laying out the paired-plots, was estimated ocularly. The current year's growth of the vegetation was clipped in all the plots. The grasses and forbs were clipped at 2.5 cm above ground level and the current year's growth of shrubs, if present, was clipped. The clipped material was sorted in to grasses, forbs and shrubs and was separately weighed with spring balance for fresh weight. The clipped material after taking its fresh weight, was air dried (AD) for about 7 days and was re-weighed for AD weight.

Soil protective cover percentage values for plant base, litter, cryptogams and rock pavement were also recorded ocularly after clipping all the vegetation in the plots. Further plants found in the study area were collected and identified. Two soil samples from surface down to 16.5 cm from each

paired plots were taken for soil analysis. Soil core was 4.25 cm. in diameter and 16.5 cm. in length. So soil sample depth was 16.5 cm below surface.

Afterwards during mid August to mid September data on species-wise cover percentage, forage production by clipping and soil protective cover values were recorded during 1st. year (1998) of the study. In second year (1999) data on these parameters were also collected starting from mid June to mid September each month.

Data on socio-economic conditions of the grazier by interview-cum-questionnaire technique remained continued.

In foot-hills ranges data on species-wise cover percentage, protective cover percentage and forage production/availability by weight-estimate were collected during November, 1999. In all the 60 quadrats, at each site, forage production/availability data was estimated ocularly. Further each 5th quadrat was clipped and the fresh and AD weights were taken. Out of 60 total quadrats in each site 12 were subjected to clipping as well as estimation for making correction in weight estimates. Plant specimens were also collected and identified.

### 2.3 Data Compilation and Analysis

Monthly forage (herbage+browse) production and utilization per hectare was calculated based on clipped material in each plot for the alpine pastures. Monthly forage utilization was calculated as a percentage of the difference of current forage production in the fenced and unfenced plots as under:

$$\text{Utilization \%} = \frac{\text{Difference in forage production}}{\text{Forage production in fenced plot}} \times 100$$

Similarly average cover percentage values of each species were calculated. Bare soil (percent), which is an indicator of soil protection was calculated from data on soil protective cover percentage values. Plant species found in the study area were classified in to different vegetation types (grass/grass likes, forbs and shrubs/trees) and their palatability classes were ascertained. Nutritional quality of the clipped material, separately for grasses, forbs and shrubs, was analyzed. Soils were analyzed for physico-chemical analysis as well as for bulk density and moisture contents.

Forage availability per ha of foot hills ranges was calculated based on quadrat data. Ocular estimate was corrected using average ratio of clipped and estimated figures obtained from every 5th quadrat. Bare soil values were also calculated. The plant species were classified into grasses/grass-like, forbs, shrubs and tree and in to palatable/non-palatable species.

The results have been presented in form of Tables. Only number, average values and percentage values are reported in the Tables. No complex statistical analysis was done. Further socio-economic information is based on the responses of the respondent. Such figures/values may or may not be over/under estimated. All such figures/values could not be ascertained by any other source.

Only final stopovers in alpine/subalpine and subtropical ranges were evaluated. The stopovers on transit could not be evaluated in this study. Main reasons were: firstly due to no prior knowledge about all the routes and secondly most difficult and remote routes and far flung stops were used by the nomads.

## 3. SYSTEM DESCRIPTION

### 3.1 People

The concept of community could not be specified and applied in this study as the graziers from different localities were grazing these rangelands. However two types of graziers, using these pastures, were identified namely the sedentary transhumant graziers who live permanently in Kaghan valley or adjacent valleys and drive their livestock to high altitude pastures in Summer and nomadic

transhumant graziers (Bakarwals) who move livestock to high altitude pastures in Summer and to the foot hills localities in NWFP and Punjab Province (northern parts adjacent to NWFP) in Winter season. The later group do not have permanent settlements. They roam in search of livestock forage. Temporarily, Afghan refugee graziers were also using these pastures particularly Basel area pastures.

Kaghan valley is abode of diverse people having different tribes/castes. Sayeds, Swaties, Awans, Qurcs, Mughals, Rajput and Pathans etc. are some of the tribes. Sayeds, Swaties and to some extent Awans are influential land owners. Others are either tenants or tenant cum-land owners. Gujars have been recorded as aboriginies who were pushed away by powerful tribes like Sayeds and Swaties. They were livestock borders either sedentary or nomadic and are still practicing same traditional grazing activities.

Sedentary transhumance graziers practice subsistence fanning. They own/rent in some arable land and cultivate crops. The crop residue and hay, made from field boundaries and hillside/parcels of grasslands, are stall fed in Winter. They keep livestock for meeting domestic needs of livestock products. Surplus livestock and their products may be sold in market. They often buy crop residues and hay from local market. Summer grazing is done in alpine and sub alpine pastures. The nomadic transhumance graziers, on the other hand, earn livelihood mostly from the sale of livestock. Livestock products like milk, ghee etc. is used by the household. They do not make hay rather they graze their livestock in alpine pastures in the Summer forests/grasslands on transit during Autumn and Spring and Foothill ranges in Winter. They may purchase green fodder for grazing during Winter. They also use leave fodder of *Olive*, *Acacia* and other shrubs in scarcity period.

### **3.1.1 Family Size and Type**

Both types of the graziers had large number (11) family size per household. Out of this total 3-4 were male members and 2-3 were female members. One was elderly and 4-5 were below 16 years of age. Only males were earning members and were 2-3 per household. About 2 were school going children of sedentary graziers only. Majority of the graziers live together in one household as extended family.

### **3.1.2 Education Level**

Nomadic graziers, almost 100 percent, were illiterate. This speaks of complete negligence by the main society and the State. The lack of educational facilities in their shanty hutments is evident. Probably, under the circumstance, it was not possible for mem to get education under nomadic life style. On the other hand large majority (50 percent) of the sedentary graziers were illiterate and only 20 percent were educated upto middle level.

### **3.1.3 State of House Ownership**

Almost 100 percent of the nomadic graziers live in tents/kacha (mud) houses which were mostly rented in. Similarly 84 percent sedentary graziers live in kacha houses and majority of them own them.

### **3.1.4 Occupation**

The main occupation of the sedentary graziers was Zamindari (land cultivation) and the main occupation of the nomadic graziers was Maldari (livestock keeping), Subsidiary occupations included teaching, tracking guide, and daily paid labour (DPL).

### **3.1.5 Land Owned/Rented in by the Graziers**

Majority of the sedentary graziers owned or rented in cultivated and non cultivated land. According to this study about 3 acres land per house hold was either owned or rented in. Average land

rented in by nomadic graziers was less than 1 acre and same was the case with uncultivated (grassland).

### **3.1.6 Crops and Crops Residue Production**

Maize, wheat, potato and peas are the major crops produced by the sedentary graziers. Maize shover, wheat straw and peas straw are stored and fed to the cattle/buffaloes. Their production, mostly due to small parcels of land, is low.

### **3.1.7 Income per Household**

On farm average annual income per house hold of sedentary grazier was Pak. Rs.21600 (1 US \$ = 51 Pak. Rs.) and off farm income was Pak. Rs. 12230/.. Nomadic grazier's off farm income was Pak. Rs.23856 (only). This annual income was too low by any standard and hardly covers daily expenses on food etc.

## **3.2 RangeIands/Pasturelands 3.2.1 Summer Grazing Areas (Alpine/Sub-alpine-zone)**

### **3.2.1.1 Area/Land Use**

The study area is comprising of 66898 ha. Out of this total 64238 ha (96%) were rangclands, 855 ha (1.3%) were forest land (sub-alpinc forests), 220 ha (0.3%) were cultivated land and rest (2.4%) was under glaciers, natural lakes and river beds.

The valley bottoms in Burawai and Jalkhad were under cultivation. Peas and Potatoes were main summer crops. All the available spots were converted into sloping fields and were planted with these crops in late May or early June and were harvested in September. Crops were irrigated using snow melt water through spreading technique. Water spreading was conventional and faulty. This technique could be improved. Fanners get good yield particularly of peas of which seed is imported from Holland. Similarly a good variety of potatoes is being cultivated. The crops are sold in big city markets like Rawalpindi and fetch good price particularly for peas as elsewhere in the Pakistan, this crop is grown in winter and is harvested in spring. Plant residues of peas are stacked for next spring use by livestock. Some farmer feed it at time of harvesting too.

Side slopes of the main valley, particularly north-western aspects around Burawai and Jalkhad were covered with sparse sub-alpine forest trees. Fir, blue pine, birch and junipers are main species. On old maps (1930) though patches/grooves of forests have been shown but now only scattered-very open wooded rangcland are found. These trees provide fuelwood and wood needs of temporary settlers (graziers). The forests are on verge of extinct due to heavy grazing and wood collection pressure. On right bank slopes scattered trees of blue pine and junipers, with relatively thick bush layer *oiArtemisia*, are found near to Burawai. Around Jalkhad such trees are absent on this slope. In Basel and Gittidas ranges no treespecies are found.

Further Jalkhad and Burawai ranges arc mostly utilized by temporary settlers (tenant fanners) who move their livestock in summer, stay there and also cultivate crops. Nomadic graziers may be found but in huts/tents scattered in far-flung areas on slopes of mountains. Basel area receives graziers from many origin. Afghan refugees having sheep herds, bakarwals (nomadic graziers) and Kaghan valley residents graze the area. In Gittidas graziers from Chilas, Diamer district, the Nas exclusively graze the range. These graziers have 5-8 temporary settlements, eacli having 50 or more huts, in the valley. They bring all the types of grazing livestock.

### **3.2.1.2 Elevation**

Elevation from Burawai upwards to Gittidas and of side valley mountains increases. The elevations (amsl) are 2955, 3080, 3161 and 3600 meters at Burawai, Jalkhad, Basel and Gittidas, respectively.

These elevation are at valley bottoms and side slopes are much higher and steeper. Babusar pass, near Gittidas is at 4184 m and highest peak is 5016 m around same location (see Figs. 1 and 2).

### 3.2.1.3 Aspects

The main mountain ranges run, more or less parallel to the main valley which is oriented from north-east to south-west. Side valleys arc like tree branches and dissect the main aspects into various exposures. Accordingly main aspect along left bank is northwestern and south-eastern. Along right bank the side valleys give rise to all the possible eight directions. The paired plots at different range sites were laid out representing all possible aspects. The slopes of these points were moderate (m) to steep(s). Very steep slopes were avoided.

### 3.2.1.4 Soils

Forty (40) soil samples from surface down to 16.5 cm. soil core being 16.5 cm long x 4.25 cm dia; two each from paired plots were collected with tube soil sampler. Labelled and packed soil samples were brought to PF1 Labs. Twenty(20) soil samples were got analyzed for physico-chemical properties from soil lab. of Agricultural Research Institute, Tamab (Peshawar) and 20 were oven dried and their bulk density was calculated.

Soils were medium in texture. Loam and silt loam types were common in the study sites. Ph and soluble salts were within safe limits. Nitrogen, Phosphorus and Potash contents were low to medium. In some pockets these elements were adequate.

Soil bulk densities of different localities of study sites were much higher than normal. This indicates heavy compaction effect of continuous seasonal grazing. This in turn badly affects water infiltration and storage capacity of soils in upper layers. Moisture contents in July—a potential growing season—varied from 7.1% in Jalkhad to 13.4% in Gittidas which was too low.

### 3.2.1.5 Land Forms

The spectacular alpine landscape of the upper reaches and side valleys came into existence due to the erosion and depositional actions of glaciers. This process is still continuing as small scale glaciers are still sitting on mountains. Ice sheets and snow avalanches are also active in transporting and depositing the glacial drift.

The characteristic alpine topographical features like cirques, horns, aretes are very conspicuous on peaks. Natural lakes, hanging narrow valleys as gorges or cirques are found in the area. Mountain and narrow valley bottoms with steep slopes are common land forms. Residual soil on ridges, exposed rocks on peaks, rock debris are also found. At places scree slopes and rock outcrops are common.

### 3.2.1.6 Vegetation Zones

Sub-alpine and alpine zones are two major ecozones in the study sites. The sub-alpine is represented by an ecozone between temperate forests and alpine zone. The vegetation has both temperate and alpine elements. In sub-alpine native species we represented are: blue pine, fir and birch among trees. *Junipers*, *Rosa*, *Berberis spp*; *Sal, spp*; and *Cotoneaster spp*. are among shrubs. A large number of grass/grass-like and forbs are also found. Around Burawai and Jalkhad scattered trees of above species were found.

In alpine zone climax rangeland vegetation in form of meadows was found. Temperate grasses are most often absent in this zone. The major range types in this zone are meadows, shrub-meadows and shrubs (Khan, 1971). In the study area 16 grasses and grass-like, 49 forbs species, 5 shrubs species and 4 tree species were recorded and identified.

### 3.2.1.7 Climate

The study area is situated in the extreme north of Hazara Civil Division i NWFP in Kaghan valley. Accordingly it is located in the sub-humid boreal and ser arid climatic zones. Area has long frozen Winters and short cold Summers. In ear Autumn gusting chilly winds blow in the valleys which decrease temperatures.

Precipitation in form of rainfall (RF) in spring-summer and snow fall (SF) Autumn and Winter months is received. Average annual precipitation recorded w. 819.1 mm RF and 764.4 mm SF. Relative humidity varies from 42 to 84 percent.

Mean minimum monthly temperature recorded for 3 years was -8.9 °C January. Mean maximum monthly temperature for same period was 24.6 °C both f July and August. Monthly temperature of range was 17.5 (lowest) for August and 26 (highest) for October. Temperature of five months January to March and November December remains below zero. Similarly mean minimum temperature for 9 mont] remain below 5 °C. Tills indicates that growing period was only 3 months.

### 3.2.1.8 Botanical Composition

All the 4 sites showed minor variations in species composition (cov percentage) and frequency. At Burawai *Agmstis - Trifoliim* community was recorde Frequency of *Trifolinm repens* was 80 percent as compared to 40 percent frequency *A. gigantea*. At Jalkhad *Alopecurns - Taraxacum* community was found with 60% ai 40% their frequencies, respectively. At Basel *Agrostis - Cerastium - Trifolin* community was recorded. Their frequencies were 100,100 and 100 percent respctivel At Gittidas *Polygonum - Taraxacum - Carvx* community was recorded with the frequencies at 100, 80 and 80 percent respectively.

### 3.2.1.9 Range Condition

Hussain (1968) had stated that range conditions were low Good to High Fair. The ocular estimate, during this study, indicated that range conditions were "Fair to Poor" with downward trend.

### 3.2.1.10 Density of Weed and Toxic Species

A few unpalatable and less-palatable species were observed. Appcndix-I lists all those species. Among grasses *Stipa* spp. was unpalatable, while *A. spicci*, *A. neferophylhtm*, *C. Incarinale*. *G. tianshanica* and *V. thapus* were unpalatable forbs. Among shrubs *E. procera* and all of the listed trees were unpalatable. Similarly there were large number of forbs with Poor (P) palatability. No toxic plants were reported/recorded in the study area.

### 3.2.1.11 Forage Availability/Yield

Due to close grazing and subsequent heavy snow fall in me Winter season, no herbage was available for grazing at start of next grazing season (June). Only fresh growth after snow melt is grazed by .the transhumant livestock. The grazing animals/move from lower to higher elevations with snow melts so measurement of forage production only in caged plots was possible. Actual clipping was done for calculation of forage yield and forage utilization.

Average seasonal (June-mid September) yield was 1100 (Kg, AD) per ha. During June the yield was 40 kg/ha, during July 380 kg/ha, during August 393 Kg/ha and , during September 287 Kg/ha. The lowest yield was recorded for June and highest for August during the season (Table 1).

### 3.2.1.12 Forage Utilization

Average monthly and seasonal yield both in caged and open plots was measured by actual clipping method. The difference of caged and open plots yield was used to calculate forage utilization percent.

The monthly and seasonal utilization was much higher than recommended 50% utilization for such ranges. The forage utilization was 20,66,71 and 69 percent for June, July, August and September, respectively. The highest utilization was recorded for the month of August (Table 2).

### **3.2.1.13 Nutritive Quality**

Percent dry matter (DM) and percent ash and crude protein (CP) on dry matter basis was determined. Results showed that grasses had lowest ash percent while forbs had highest value for this content. Crude protein was highest in forbs except in forbs of Gittidas.

Dry matter digestibility (IVDMD%) was also determined separately for grasses, forbs and shaibs (Fodder leaves). However, the grasses, forbs and shrubs were not sorted species wise rather all grass species were together and same was the case for forbs and shrubs. In grasses digestibility was highest for July cut and lowest for September cut. For forbs and shrubs there was no set pattern. On the average on seasonal basis the digestibility varied from site to site and vegetation type to vegetation type (Tables 3 and 4).

### **3.2.1.14 Management (Seasonal Movement)**

Herd movement by both the groups of graziers coincides with sowing and harvesting of the crops. Sedentary graziers start movement after sowing summer crops in the valley and return back at time of harvesting. They start moving upwards from 2nd week of May to 3rd week of June and start downward journey in 3rd week of September and reach back during first week of October - the time for crop and grass harvesting. Similarly nomads start their journey upwards during first week of May to the last week of June at a time when wheat crop is harvested in areas around their winter grazing land.

### **3.2.1.15 Routes/Stops**

Sedentary graziers move their livestock along main valley road. They make stops at 7 places for one night, each, where they feed hay to the livestock. The nomadic graziers use 3 routes. Large number of graziers move along ridges/mountain tops on left and right sides of the Kunhar River. A few of them also use main valley road. They make 23 stops on right or left sides and 13 stops on main road. At each stop they stay for one or two nights and graze the livestock. Every day they cover about 15-24 Km before night camping.

### **3.2.1.16 Grazing Pattern**

At final camping sites both the graziers graze their livestock daily for 9-11 hours by herding. Water is provided daily and salt once in 9-10 days (Table 22). Sedentary graziers use Suj to Basel pastures in Summer and Kaghan, Balakot and Shohal in Fall and Winters. A few may move their livestock, particularly buffaloes, to Haripur for Winter feeding on cultivated crops. In this case only a few male members move to Haripur. While nomads graze about S of the pastures in Summer and Haripur, Khanpur, Taxila and Attock area pastures in Fall through Spring seasons.

### **3.2.1.17 Household Members and Livestock Stay Back Home**

Nomadic graziers drive all the livestock to higher altitude. Same is the case with the household members. Since they do not have permanent hutments in winter grazing areas so all the members had to move with livestock. On the contrary the sedentary graziers have their houses in lower parts of Kaghan valley. It is reported that 1-2 milch animals are kept at home to meet the milk needs of the remaining household members. Similarly, sick and elderly people do not move upwards with livestock. Further the male members of the household move between their summer huts and permanent huts/homes back in villages/town in lower valley parts to take care of the remaining members and stock.



### **3.2.1.18 Community Decision**

Each household makes decision independently regarding livestock movements, sale and purchase of livestock and their products. The decision making processes vary among nomadic and sedentary graziers. It has been reported that decisions, predominantly, are made by the male household heads among sedentary graziers. On the other hand nomadic graziers consult with their wives and collectively decision are made.

### **3.2.1.19 Grazing Rights/Fee**

Rights and concessions for grazing and grass cutting for local communities exist in all the State forests of Kaghan valley. These rights and concessions are exercised by local people unless prohibited on silvicultural grounds in part of forest land. Similarly full such rights and concession are exercised in the community forests known as "Guzara" forests in NWFP. Grazing on common range lands owned by community and or individually owned land, after harvesting grass for hay, is allowed.

The alpine pastures are collectively owned by the "Saved" tribe of Kaghan town. In otherwards the proprietary right rests with a specific tribe and hence they charge grazing fee for it. The receipt of grazing fee is a bit complicated. The tenants of Sayeds residing in revenue jurisdiction of Kaghan town - from village Loharbanda to Naran town - graze free of any cost as a tenancy right. All other sedentary graziers from Kaghan valley are supposed to pay a nominal grazing fee as under:

Cow/buffalo = Rs.2.00

Goat/sheep = Rs.0.25

Horse/mule = Rs.0.50

The above rates were fixed during first regular settlement of the District in 1872. These rates, though not officially increased, are not applicable and a fee not less than of Rs.5/- per head per season is charged or a lump-sum for a particular site is charged (Table 25). A group of graziers buy it and pay according to their number of stock. For example there are two main owner families of Kaghan rangelands. One of them charges Rs.0.10 million per season for his chunk of rangelands. This could not be ascertained by any other source.

These rates/fee arrangements apply to Burawai, Basel and Jalkhad study sites. The graziers of Gittidas do not pay any fee as they claim it their community land. As stated earlier graziers of Gittidas belong to Chilas, Diamer district (Nas).

## **3.2.2 Winter Grazing Areas (Dry Sub-tropical Broad Leaved Forest Grazing Lands)**

### **3.2.2.1 Location**

Most of the geographical areas of the Haripur district (NWFP) fall under this zone. Haripur and Khanpur are two of the major cities which have large acreage under this ecozone where scrub forests (*Olea- Acacia*) are found. Besides large tracts under grasslands are also found. These areas are visited by the nomadic graziers who graze their livestock in and around these forests in the Winter and Spring seasons.

### **3.2.2.2 Area**

Attock, Rawalpindi and Fatch Jang are 3 adjoining districts of the Punjab province. These also have similar forests and grasslands. Taxila, Hassanabdal and Fateh Jang are the cities/town in these districts which are winter grazing areas of the nomadic graziers. All these districts command large tracts of scrub forests. The forest areas, in and around the listed cities only, are given as under:

S.No.	Localities	Forested rangelands (ha)
1.	Haripur (including Khanpur)	21616
2.	Taxila (Rawalpindi)	8135
3.	Hassanabdal	1011
4.	Attock	29328
5.	Fateh Jang	15366
	Total:	75456

Most parts of the above areas are the Guzara (Community) forests, particularly in Haripur and rest is the state owned. Further a large chunk of the community grass lands and individually owned grasslands are also available for free grazing in winter.

### 3.2.2.3 Elevation and Climate

These areas are located in the foothills and lower slopes of the Himalayas, the Salt range and Kalachitta between sub tropical thorn forests and sub-tropical pine forests. Their elevation varies between 450 m to 1525 in above sea level. Long dry season is tempered with Winter, Spring and Monsoon rainfall. Precipitation varies from 250 mm to 760 mm in the year. Temperatures are high in June-July with monthly mean maximum from 29.4 to 33.3 °C. December-January are the coldest months with mean minimum of about 10 °C. Frost may occur in winter months.

### 3.2.2.4 Botanical Composition

The characteristic tree species are *Olea cuspidata* (Olive), *Acacia modesta* (Acacia). Shrubs genera include *Dodonaea*, *Wilhanici*, *Viazyci*, *Gymnosporia*, *Monothea* and *Carrisa*. Among grass the genera of *Cryposogon*, *Cymbopogon* and *Heteropogon* are common. The species found and identified in Taxila and Khanpur study sites are reported in Appendix-II.

### 3.2.2.5 Forage Availability/Yield

The Winter season grazing lands of nomads are actually summer lands for grazing of the livestock of local communities. The grasslands are also harvested for hay in September-October. After harvesting the areas may be grazed till Spring. The nomadic livestock graze such areas both in spring when they move upwards and in late autumn and winter on their return to these foot hill ranges. Obviously there is very little forage available for winter grazing/browsing and that too in form of left over stubble or re-growth (aftermath). These ranges are over grazed.

Since these areas were evaluated once only in October/ November so at that time available forage was 467 Kg/ha (AD). This quantity is too low for Winter and spring seasons use by large number of nomadic livestock (Table 5).

### 3.2.2.6 Grazing Rights/Fee

Most forests in these areas are closed to grazing and graziers have no grazing right. In spite of it illicit grazing incidents occur in the forest which, occasionally turns in to violent resistance by the Forest Departments.

In most cases the graziers buy grazing lands from private owners for Winter grazing or have some kind of barter arrangements. In lieu of grazing they give farm yard manure to the owners of lands or some other livestock products. However, they face difficulties in procuring grazing areas. Accordingly, some of the graziers purchase Winter fodder crops for grazing or stall feeding.

### **3.3 LIVESTOCK**

#### **3.3.1 Livestock Population Per Household**

In Kaghan valley, the semi-nomadic and nomadic graziers, keep cattle and buffaloes of non-descript type which are cross bred of important breeds of plain areas of Pakistan. Local breed of cattle called Achi/Gabrali is commonly found. Similarly cross bred of Kundhi breeds of Buffaloes is common. Kaghani breeds of sheep pure and cross breeds of Rambouillet are found. Gaddi and Kaghani breeds of goats are kept for meat, hair and milk.

The livestock population grazing the study sites was out of the scope of this study. It needs a separate full scale study to enumerate the livestock population as the graziers move their livestock to the remotest corners of the ranges.

For this study average number of livestock per household was calculated based on information provided by the respondent graziers from whom data was collected on questionnaire. According to the study the herd size of Bakarwals was 149 head. Of this total 108 (72%) were goats, rest 40 (27%) were sheep and 1 (0.8%) was equine. They do not keep buffaloes or cattle. Details of ewes, nannies and their young stock and lambs/kids are provided in Table 6.

On the other hand sedentary transhumance graziers keep buffaloes, cattle, goats, sheep and even equine. Yaks are not reared in this part of the country. This group, on the average, keeps about 12 livestock head. Out of this total 5 (42%) were goats, 5 (42%) cattle, 1(8%) buffalo and 1 (8%) equine. This group interestingly had no sheep stock. Male, female, young and calf/kids details are provided in Table 7.

#### **3.3.2 Lambing/Calving**

Nomadic transhumant graziers have clearly specified periods for breeding and lambing. About 2 years old sheep or goat are bred and the breeding period is September-October and lambing period is February-March for sheep and goats. They keep lambing interval of about 6 months. For every 100 ewes/nannies they keep 2 rams/male goat. The adult males of sheep and goats are herded separately in non-breeding periods. The sedentary graziers have no specified time period for breeding or calving/lambing. The breeding age for cow or buffalo is 4-5 years with about 16 months calving/interval.

#### **3.3.3 Livestock Products**

Milk, Ghee (Butter oil) and wool are the main livestock products of the transhumant graziers. The lactation period for sheep/goats is 5 months, for cow it is 7 months and for Buffalo it is 8 months. Accordingly milk and milk products per animal units are very low. Market structures for sale of livestock and these products are existing and are known to the graziers but they are consuming almost all the products (milk and ghee) except wool. Further dung is used by the sedentary graziers in their fields while nomadic graziers under terms and conditions, give free of cost to their house/land owners.

#### **3.3.4 Health Care/Mortality of Livestock**

The graziers have reported that fever, cold and tuberculosis are some of the common diseases of the transhumant livestock. They treat the sick and weak livestock head with some of the known antibiotic and antiworms medicines available in the market. Mostly treatments are given during the winter season when livestock are in proximity to big towns or cities. The medicinal plants are used as treatment when livestock are in alpine pastures. They occasionally use Terramycin and Nogovan injections or neclwonn (a traditional medicine). A Veterinarian doctor (by personal contact) informed that following diseases are common amongst the transhumant livestock for which different medicines (mentioned against each) are prescribed for the treatment:

S.No.	Type of Livestock	Common diseases	Medicines for treatment
1.	Buffalo/cattle	Hemorrhagic septicaemia (HS)	Diadine, Oxytetracycline + H.S.V. thrice a year
		Pneumonia	Penicillin and Terramycin
		Eczema	Sulphur ointment
		Piroplasmosis (red water)	Acaporine, Imizol, Oxytetracycline
2.	Sheep/goad	Piroplasmosis (red water)	Acaporine, Oxytetracycline and Polybotec
		Pneumonia	Terramycine and Penicillin
		Eczema	Sulphur ointment
		Enterotoxemia	E.T. vaccine
		Anthrax	Anthrax spore vaccine (ASP) in August and Penicillin

### 3.3.5 Wild Herbivores

Major types of wildlife herbivores like *Ibex (Capra ibex)*, *Musk deer (Moschus moshiferous)* may be found in these pastures. However, their population is not known. Probably it is very rare. Similarly *Goral (Nciemorhediis goral)* may also be distributed but very few number. All these species are listed to be present in this zone being their habitat. Herbivorous Rodents may also be found in the alpine zones.

## 3.4 Fodder and Feed Supply Situation

### 3.4.1 State of Availability to Sedentary Graziers

Hay, maize stovers and wheat straw are major fodder available to the sedentary grazier for winter feeding. They collect and store these types of fodders from their own/rented lands and also buy from other sources. Green grass is available to them for grazing and stall feeding from April through October. They face scarcity of feed for two months - Jan and Feb.

The winter grazing areas (Temperate and sub-tropical humid zones in Kaghan Valley and sub-tropical sub-humid zone in foothills of NWFP and Punjab province) of the nomadic and semi nomadic graziers are protected from grazing during summer growing season (mid July to mid September) and grasses/forbs are harvested for hay-making from mid September to mid October manually using sickle. The handful bundle of the harvested material is air dried at site. After 3-4 days of drying these small bundles are tied together to make a bigger bundle. These bundles (8-10 Nos.) are piled together for further drying in the field. Finally, the dried and piled herbage is collected and brought, as head load close to the livestock huts or farmer's houses and stored/staked in open or on trees (occasionally) for winter feeding.

### 3.4.2 State of Availability to Nomadic Graziers

The nomads feed fodder crops (*Trifolium* spp.) and tree leaves/twigs to their livestock in January to April. Green grass for grazing/feeding is available to them from June to September. Mostly

their livestock depends on grazing through out the year. They also face scarcity of feed during Jan. and Feb.

### **3.4.3 Silage**

Silage is not prepared by both the types of graziers. Rarely supplementary feed in form of oil Cake, molasses, grains etc. are fed to weak/sick and old animals.

## **4. CONCLUSION**

### **4.1 Pastoralist's Perceptions of Problems and Needs**

**4.1.1** The study indicated that the prevailing land tenure, the tenancy systems and traditional land use pattern in the Kaghan valley are driving forces for transhumance grazing of the high altitude alpine pastures. The unequal land distribution has forced the less privileged people to drive their livestock to alpine pastures and bring them back to lower valley parts and foothills of NWFP and Punjab province for Winter grazing. They also rely on privately owned common lands and public land for subsistence. This arrangement tends to be exploitative under the prevailing socio-economic conditions and relationships with natural pasture production systems are keeping the pastoralists in poverty and the system is deteriorating.

**4.1.2** The study revealed that subsistence livestock production system of the transhumant grazing is being practiced by the pastoralist. The graziers try to cope with the fodder and forage requirements of their livestock. To meet the feed requirement they move the livestock to different pastures in different ecozones, purchase the crops residue and fodder crops for Winter stall feeding and grazing, respectively. However the sedentary graziers do not grow Summer or Winter fodder crops or make silage. The absence of any technical input by the State for improved pastures and lack of appropriate technology has resulted in such traditional grazing. Similarly livestock and their production are not market-oriented though market structure exists in the region.

They tend to produce livestock products for domestic needs and sell it if surplus. Similarly livestock are sold according to the cash needs of the household.

**4.1.3** The study also indicated that all type of decision regarding livestock are made by the household heads. All such decisions are made independently by priorities. It appears that sustained food and fodder supply and self sufficiency are their motivation and objectives. There is a great potential for the participatory approach to improve the systems if the State wishes to improve the prevailing traditional pasture use.

**4.1.4** Though detailed perception analysis and discussion in this regard was not carried out yet the participants were asked about their problems related to livestock production system. Both types of graziers, though in small percentages, have stated 5 problems/issues. Their problems were related to no permission of grazing in the forests, fodder shortages, losses of animals in transit, no arrangement for transport of livestock and restrictions from local people to grazing. Solution to these problems were their major needs.

**4.1.5** They could not realize their state of landlessness. Lack of permanent settlements, lack of education and other basic necessities of livelihood. Probably they had adapted to miserable nomadic life due to sheer neglect by State for so long. Their life is very hard and they are encircled by the poverty and miseries yet they are determined to struggle hard. They are facing these problems with courage and hope for the best.

## **4.2 Prospects for Improvement in the Management**

**4.2.1** Subsistence livestock production practices are being adopted by the pastoralists of high altitude alpine pastures of Kaghan valley. Traditional repeated Summer grazing of alpine areas and Winter grazing of foothill rangelands for livestock survival is being practiced since centuries. Apparently they are not looking for change in near future.

**4.2.2** Natural pasture production systems which are constrained by physical environmental factors is on decline. Poor shallow soils, steep slopes, dissected topography, loose rocks/stones covering large areas, scanty precipitation, low temperatures leading to short growing periods, cold winds and frosty nights are some of the major causes of low productivity. Superimposed on it heavy grazing, no technical inputs, non conducive tenural arrangements and poverty are also taking their toll.

**4.2.3** In spite of all these constraints there is silver lining in the clouds. Application of sound management principles may help improve the system. There is no or negligible scope for artificial seeding for vegetation improvement as most of the level to moderately sloped patches are being cropped and are still being converted to sloping fields. Instead natural seeding through deferment and rest grazing management could be achieved. Intensive grazing plan for remote and less utilized portions of the ranges could be another option. However, patches of weeds could be sown with promising grass/legume species after their manual removal. Further sloping abandoned fields could also be sown with nutritious and high yielding forages. Soil moisture shortage could be improved through water spreading techniques and other soil and moisture conservation measures.

**4.2.4** The owners and users of these pastures could be bound by rational land use policies. Trained and dedicated staff be posted for such works. The range management services be made a career oriented agency.

**4.2.5** Foothill ranges have great improvement potential. Policies, rules and regulation for its improvement and utilization had to be formulated. Instead non-productive forested areas these could be converted into an open woodland productive ranges. These areas could be developed into a productive forage reserves for the nomadic graziers and these could be given long leases to graziers.

**4.2.6** Forage shortage in Winter season in the Kaghan valley must be properly addressed. Fallow lands in Winter season could be sown with improved cool season grasses or legumes. Silage making process be introduced in the area and forage supply situation from the other areas could be improved.

## **4.3 Focus for Further Research**

**4.3.1** This informatory study has attempted to analyze the high altitude alpine pasture pastoral production and utilization systems. The systems have been described according to base line data. However, this study emphasizes the comprehensive and precise interdisciplinary research. For holistic understanding of the systems, specialized contribution by the natural and social scientists are needed. This should lead to the identification for the most important elements and variables that influence the system.

To achieve this the disciplinary application-oriented research in the following field be carried out:

1. Rangeland rehabilitation and improvement
2. Fodder and cereal crops yield improvement
3. Livestock improvement and
4. Institutional improvements.

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## 6. TABLES

**Table 1.** *Seasonal forage production (AD,Kg/ha) of High Altitude Alpine Pastures at different sites*

Months	Grass	Forbs	Shrubs	Total
June	11	21	8	40
July	94	242	44	380
August	106	251	36	393
September	72	187	28	287
Total for season	282	701	116	1100

**Table 2:** *Range utilization (%) during grazing season at different sites*

Months	Grass	Forbs	Shrubs	Cumulative
June	21	17	32	20
July	68	70	62	66
August	74	73	60	71
September	67	73	63	69

**Table 3.** *Average quality of forages of different sites of High Altitude Alpine Pasture*

Sites	Clipped Material (Air Dried)	Dry matter (%)	Percent on dry matter basis	
			ASh	Crude protein
<i>Burawai</i>	<i>Grass</i>	93.78	9.99	13.89
	<i>Forbs</i>	92.94	20.20	15.64
	<i>*Shrubs</i>	92.22	12.44	16.68
<i>Jalkhad</i>	<i>Grass</i>	74.84	12.52	16.40
	<i>Forbs</i>	90.87	21.55	16.01
	<i>Shrubs</i>	90.46	16.26	19.70
<i>Basel</i>	<i>Grass</i>	91.96	9.32	15.49
	<i>Forbs</i>	91.42	16.86	19.44
	<i>Shrubs</i>	90.97	14.61	18.95
<i>Gittidas</i>	<i>Grass</i>	90.67	10.93	16.78
	<i>Forbss</i>	90.81	12.77	11.57

\*Average of Artemisia and Astragalus



**Table 4. Invitro dry matter digestibility (IVDMD%) of forage of alpine pastures (1998)**

Location/mont		Grass	Forb	Shrub
Basel	July	74.88	76.31	-
	August	67.25	71.87	80.84
	September	60.88	34.77	-
	Average	67.67	60.98	80.84
Jalkhad	July		42.59	-
	August	40.29	41.64	62.57
	September	44.79	44.84	-
	Average	42.54	34.02	62.57
Gittidas	July	50.27	49.36	-
	August	46.72	43.45	-
	September	45.07	79.01	-
	Average	47.35	57.27	-
Burawai	July	62.07	63.89	63.32
	August	51.12	69.81	71.39
	September	50.52	64.80	57.57
	Average	54.57	66.16	64.09

**Table 5. Forage availability production (AD,Kg/ha) of Winter Range at Khanpur and Taxila Areas**

Name of sites	Grasses	Forbs	Shrubs	Total
Khanpur (Dara)	186	9	257	452
Taxila (Thatha Khalil)	304	15	163	482
Average	245	12	210	467

**Table 6: Livestock population/household of Sedentary transhumant graziers**

Type	Adult		Young		Calf/Kids/Lambs		Total	
	M	F	M	F	M	F	M	F
Buffalo	0.05	0.80	0.05	-	0.20	0.12	0.30	0.92
Cow	0.90	1.80	0.35	0.50	0.28	0.62	1.53	2.92
Goat	0.88	2.04	0.04	0.08	1.50	1.10	2.42	3.22
Sheep	-	-	-	-	-	-	-	-
Horses/mules	0.35	-	-	-	-	-	0.35	-
Donkey	0.08	-	-	-	-	-	0.08	-

Total Livestock heads	2.26	4.64	0.44	0.58	1.98	1.84	4.68	7.06
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**Table 7: Livestock population/household of nomadic transhumant graziers**

Type	Adult		Young		Calf/Kids/Lambs		Total	
	M	F	M	F	M	F	M	F
Buffalo	-	-	-	-	-	-	-	-
Cow	-	-	-	-	-	-	-	-
Goat	2.20	75.00	8.30	9.20	1.40	2.00	11.90	96.20
Sheep	1.10	26.10	3.60	3.80	2.10	3.20	6.50	33.10
Horses/ mules	0.53	0.47	-	-	-	-	0.53	0.47
Donkey	0.33	-	-	-	-	-	0.33	-
Total Livestock head	4.16	101.57	11.90	13.00	3.50	5.20	19.26	129.77

**Appendix-I:**

**List of plant species found and identified at different sites of the study area (June 1998 to September, 1998)**

Botanical Name	Sites				Palatability
	Burawai	Jalkhad	Basel	Gittidas	
<u>A. Grasses and grass-likes</u>					
Aira sp	*	*	-	-	P
Alopecurus arundinaceus	*	*	-	-	E
Agrostis gigantea	*	*	*	-	E
Chrysopogon echinulatus	*	-	-	-	E
Carex sp	*	*	*	*	G
Calamagrostis pseudophragmites	-	*	-	-	P
Dactylis glomerata	-	*	-	*	E
Festuca arundinacea	-	-	-	-	G
Lolium sp.	-	*	-	-	G
Oryzopsis lateralis	*	-	-	-	G
Poa alpina	*	*	*	*	G
Poa annua	-	-	*	*	G

Piptatherum sp	*	-	-	-	P
Pennisetum lanatum	-	*	*	-	G
Stipa sp	*	-	-	-	Nil
Trisetum spicatum	-	*	-	-	P
<b>B- Forbs</b>					
Arenaria filiformis	*	*	*	-	P
Astragalus leucocephalus	*	*	*	-	G
Achillea mosegeria	*	*	*	*	P
Aenomone spica	*	*	*	*	Nil
Anaphalis contorta	*	*	*	*	F
Acontium heterophyllum	-	-	*	-	Nil
Bupleurum longicaule	-	*	*	-	F
Cerastium cerastioides	*	*	*	*	F
Cynoglossum lanceolatum	*	*	*	*	F
Chenopodium album	*	*	*	-	P
Calanthe tricarinata	*	-	-	-	Nil
Dracocephalum nutans	*	*	*	-	P
Dianthus crinitus	*	*	-	-	F
Echinops nivetus	*	*	-	-	F
Equisetum sp	*	*	*	-	P
Erigeron patentisquama	*	*	-	-	P
Fragaria vesca	*	*	*	-	F
Fern sp	*	*	*	*	P
Galium aparine	*	*	*	-	P
Galium boreale	-	-	*	*	P
Geranium nepalense	-	-	*	*	F
Gentiana tianshanica	-	-	-	*	Nil
Impatiens sp	*	*	-	-	P
Iris hookeriana	-	*	*	-	P
Lotus corniculatus	*	*	*	-	G
Launaea sp	-	*	-	-	P
Leontopodium alpinum	-	-	-	*	P
Medicago lupulina	*	-	-	-	G
Minuratia lineata	*	*	*	-	P
Malva sp	*	*	-	-	F
Nepeta spicata	-	-	*	-	P
Oxyria digyna	*	*	*	*	P
Potentilla sibbaldi	*	*	*	*	G
Potentilla gelida	*	*	*	*	G
Potentilla arnavatensis	-	-	-	*	P

Polygonum aviculare	*	*	*	-	P
Polygonum plebejum	*	*	*	-	P
Polygonum affine	*	*	*	*	P
Plantago ovata	-	*	-	-	G
Plantago major	-	*	-	-	G
Phlomis bracteosa	*	*	*	*	P
Rumex nepalensis	*	*	-	-	P
Ranunculus laetus					
Senecio chrysanthemoides	-	*	-	-	P
Taraxacum officinale	*	*	*	*	E
Trifolium repens	*	*	*	*	E
Trifolium pratense	-	*	-	-	E
Thymus serpyllum	*	*	*	-	F
Verbascum thapsus	*	*	-	-	Nil
<u>C-Shrubs</u>					
Astragalus candolleenus	*	*	*	-	E
Artemisia vulgaris	*	*	-	-	P
Ephedra procera	-	*	*	-	Nil
Rosa webbiana	*	*	*	-	F
Sambucus nigritiana	*	*	*	-	P
<u>D- Trees</u>					
Abies sp	*	*	-	-	Nil
Juniperus communis	*	*	-	-	Nil
Juniperus wallichiana	*	*	-	-	Nil
Pinus wallichiana	-	*	-	-	Nil

Note: \* = Species are found at study sites - =Not found at study sites E = Excellent F=Fair G= Good P= Poor Nil= Not palatable

**Appendix-II: List of species found and identified in Winter season Ranges area in Khanpur and Taxila Areas (November, 1999)**

Name of species	Name of Sites		Palatability
	Khanpur (Dara)	Taxila (Thatha Khalil)	
<u>A- Grasses and grass-likes</u>			
<i>Aristida depressa</i>	*	*	F
<i>Bothriochloa vertusa</i>	*	*	G
<i>Carex sp.</i>	-	*	G
<i>Chrysogon montanus</i>	*	*	E
<i>Cynodon dactylon</i>	*	*	G
<i>Cenchrus setigerus</i>	*	*	G
<i>Cymbopogon iwarancusa</i>	*	*	P
<i>Desmostachya bipinata</i>	*	*	P

<i>Eragrostis minor</i>	*	*	F
<i>Hetronogon contortus</i>	*	*	F
<i>Panicum antidotale</i>	*	*	G
<i>Pennisetum orientale</i>	*	-	G
<i>Saccharum sp</i>	*	*	P
<i>Themeda anathera</i>	*	*	E
<i>Tetrapogon villosus</i>	*	*	F
<u>B- Forbs</u>			
<i>Ajuga bracteosa</i>	*	*	P
<i>Boerhaavia diffusa</i>	*	*	P
<i>Chenopodium album</i>	*	*	P
<i>Medicago polymorpha</i>	*	*	G
<i>Salvia moorcroftiana</i>	*	-	P
<i>Thymus sp</i>	*	*	F
<i>Verbascum tansus</i>	*	*	Nil
<u>C- Shrubs</u>			
<i>Adhatoda vesica</i>	*	*	Nil
<i>Artemisia scoparia</i>	*	*	P
<i>Carissa spinanarum</i>	*	-	F
<i>Calotropis procera</i>	*	*	Nil
<i>Dodonaea viscosa</i>	*	*	F
<i>Otostogia limbata</i>	*	*	F
<i>Peripluca aphylla</i>	*	*	P
<i>Zizyphus mauritiana</i>	*	*	G
<u>D- Trees</u>			
<i>Acacia modesta</i>	*	*	G
<i>Acacia nilotica</i>	*	-	G
<i>Ficus sp.</i>	*	-	P
<i>Grewia sp.</i>	*	-	G
<i>Monothea buxifolia</i>	*	*	P
<i>Olea cuspidata</i>	*	*	F

Note: \*=Species are found at study sites -=Not found at study sites E= Excellent F=Fair G=Good  
P=Poor Nil= Not palatable